

# DAIMLERCHRYSLER

HVAC Evap freeze test - with reduced test time

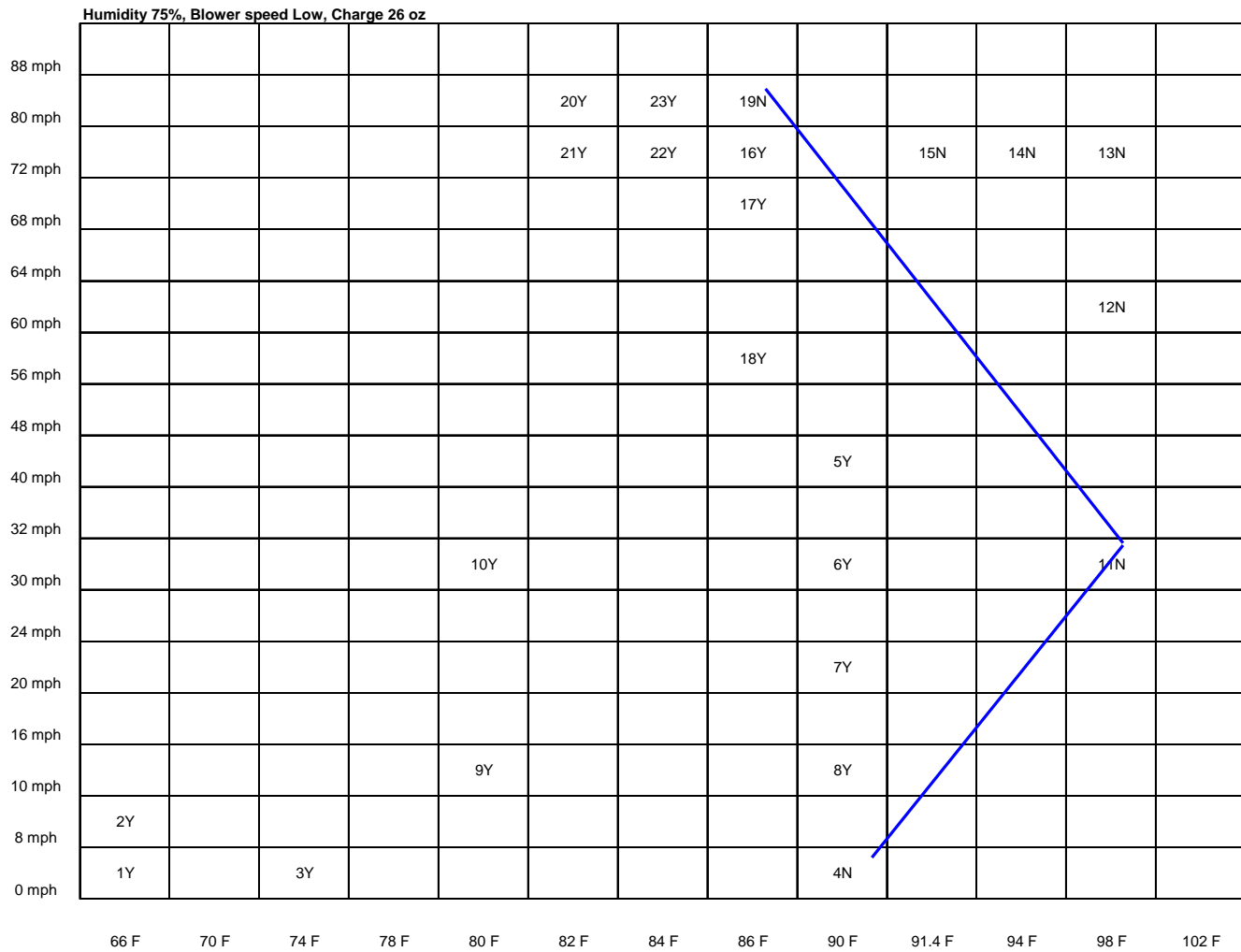
## HVAC Evap freeze test - with reduced test time

- HVAC Evap freeze control tests are time consuming tests in the drive cell
- FC6090 test at 60F, 90% RH, 65 mph and has 4 segments of total – 315 minutes (5 hr 15 minutes)
- FC7090 test at 70F, 90% RH, 65 mph and has 4 segments of total – 315 minutes (5 hr 15 minutes)
- FC8080 test at 80F, 80% RH, 65 mph and has 4 segments of total – 315 minutes (5 hr 15 minutes)
- FC9060 test at 90F, 60% RH, 65 mph and has 4 segments of total – 315 minutes (5 hr 15 minutes)
- FRZDYN7090 test at 70F, 90% RH, drive cycle is dynamic (suburban, city traffic, highway driving) and has 7 segments of total – 95 minutes (1 hr 35 minutes)
- Total hours of freeze testing – 22 hr 35 minutes
- Recommended test procedure is using the mapping – Compressor clutch transition boundary

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- Recommended test procedure is using the mapping – Compressor clutch transition boundary
  - Relative Humidity (75%), Refrigerant charge, HVAC control head set to fresh air, and blower setting (low) are kept constant
  - Ambient temp and vehicle speed are varied to record the compressor clutch cycling (number of cycles or no cycles). Test duration is about 10-15 minutes at each point
  - Compressor clutch cycling map was created – to find the regions where there is no clutch cycling or a minimum number of cycles. A line is drawn on through zero cycling points

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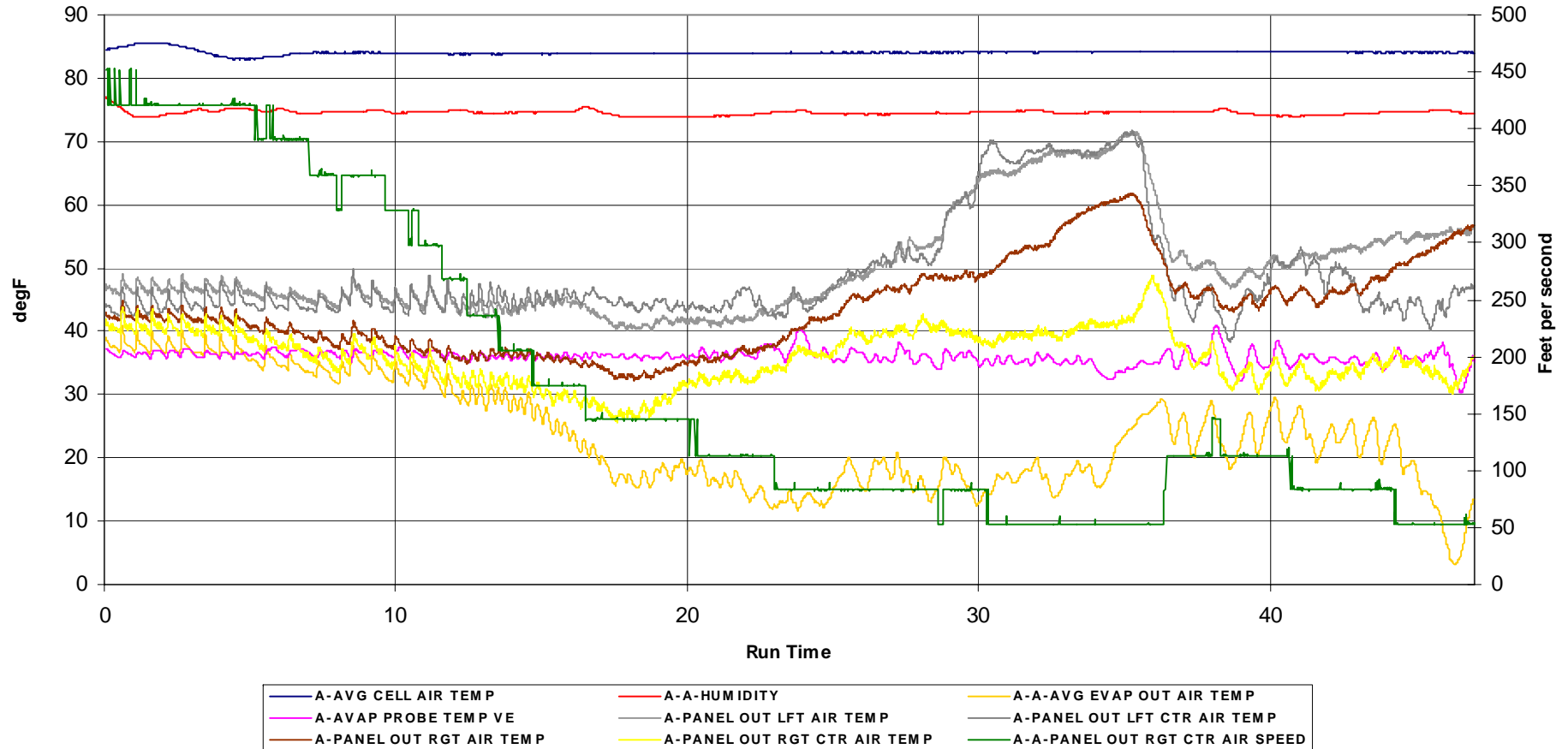
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Condition #	Ambient temp Deg F	% RH	Blower speed setting	Veh. Speed, mph	Blower current, Amps	Disc Charge temp, Deg F	Evap in temp, Deg F	Average Evap out temp, Deg F	Clutch cycling Y/N	Number of Cycle/ min	Duty cycle	Evap grid min/max
1	66	75	Lo	0	2.9	131	73	33/41	Y	5	45	
2	66	75	Lo	8	2.8	143	73	33/41	Y	5	39	
3	74	75	Lo	0	2.7	165	106	38/41	Y	1	92	
4	90	75	Lo	0	2.7	182	122	50	N	0	100	
5	90	75	Lo	40	3.1	182	93.9	39/42	Y	2	89	
6	88.4	75	Lo	30	3	169	91.4	37/45.4	Y	2	70	
7	88.4	75	Lo	20	2.9	172	94	37/42	Y	2	87	
8	90	65	Lo	10	2.7	173	96	38/41.4	Y	5	70	
9	80	75	Lo	10	2.8	166	92	36/40.7	Y	5	58	
10	78	85	Lo	30	2.9	167	81	37/44	Y	4	73	
11	98	75	Lo	30	2.9	183	101	46.7	N	0	100	40/49
12	98	75	Lo	60	3.4	195	101	48.1	N	0	100	40/53
13	98	75	Lo	72	3.7	200	102	50.7	N	0	100	42/56
14	93.8	75	Lo	72	3.7	197	96	46.1	N	0	100	37/51
15	91.4	75	Lo	72	3.6	194	93	43.3	N	0	100	35.8/49
16	86	75	Lo	72	3.8	190	85.6	36.9/50	Y	2	86	27/49
17	86	75	Lo	68	3.7	190	88.7	36.2/44	Y	2	79	30/47
18	86	75	Lo	56	3.5	185	86.5	35.8/45	Y	6	78	
19	86	75	Lo	80	4	195	87	38.3	N	0	100	30/43
20	82	75	Lo	80	4	189	81.7	37.9/46.1	Y	5	80	26.9/41
21	82	75	Lo	72	3.8	186	84.4	34/49.3	Y	2	76	27.2/42
22	84	75	Lo	72	3.8	193	86.1	36/42	Y	2	85	27.7/46
23	84	75	Lo	80	3.9	196	86.5	36/43.3	Y	3	85	26.8/42
24			Lo									
25			Lo									

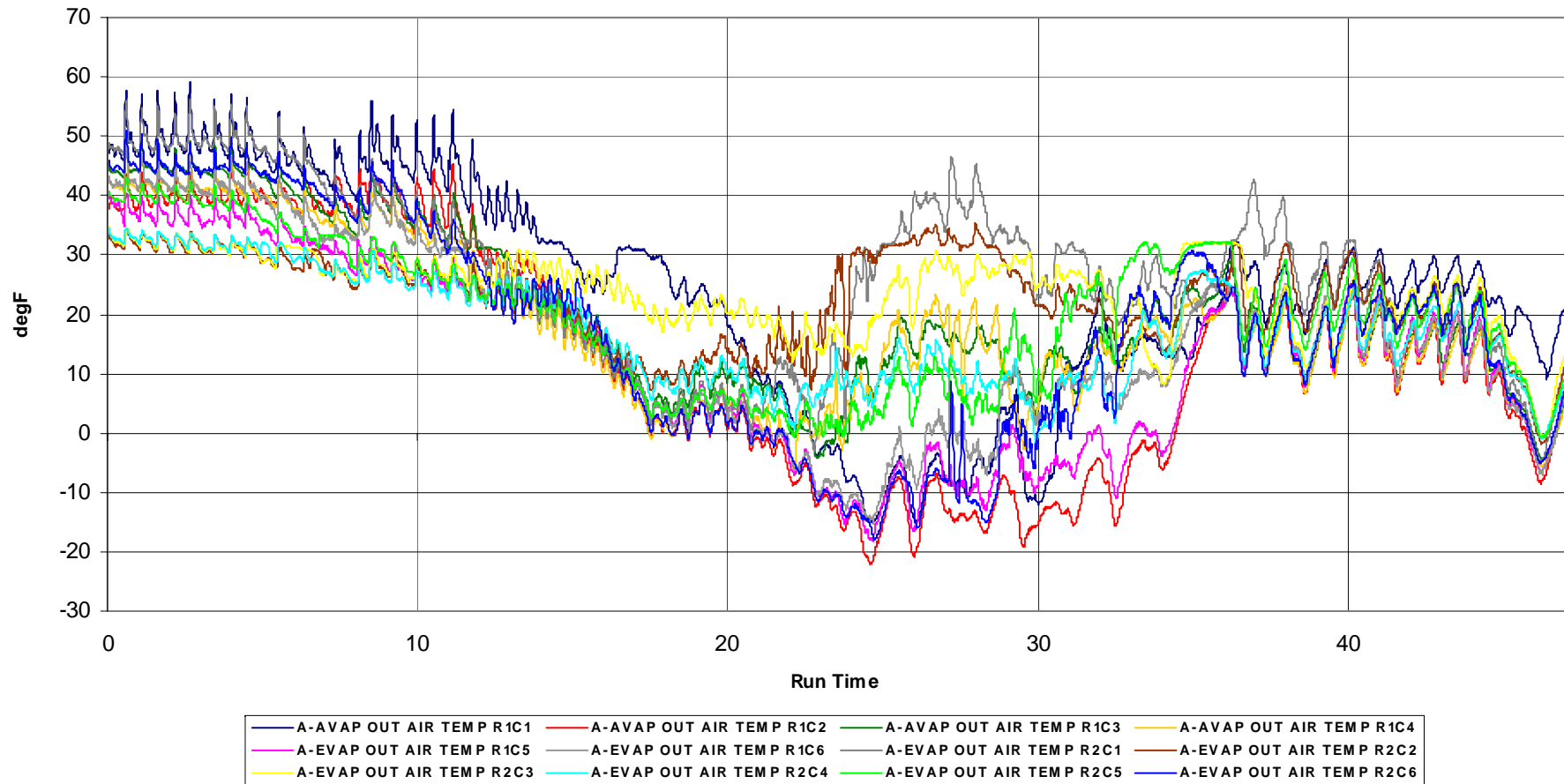
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- In the spread sheet, the compressor cycling is highlighted in yellow color
- Panel out right center air speed was recorded by using a anemometer
- From 19N (86F, 80 mph) was selected because the compressor was not cycling and the Evap temp was low. Tested for about three hours but no freeze-up
- Moved to next point 23Y (84F, 80mph) with 3 cycles per minute with the lowest Evap temp
- Evap was frozen start in 5 minutes and maximum reduction in panel out air speed was at 31 minutes of testing
- At the same point the humidity was varied to 85%, Evap was frozen start in 113 minutes and maximum reduction in panel out air speed was at 162 minutes of testing

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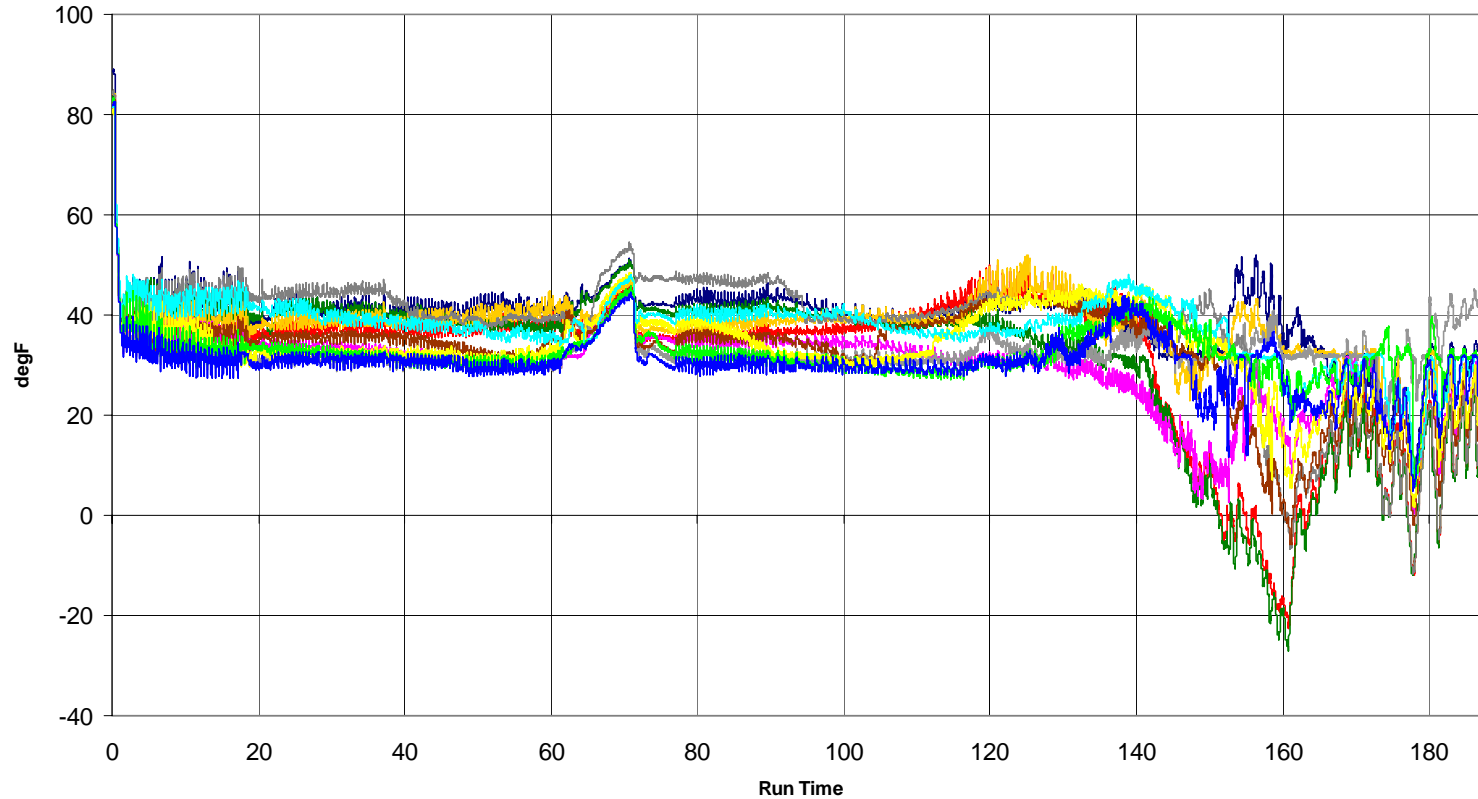


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84F, 85% RH, 80mph



A-EVAP OUT AIR TEMP R3C1	A-EVAP OUT AIR TEMP R3C2	A-EVAP OUT AIR TEMP R3C3	A-EVAP OUT AIR TEMP R3C4
A-EVAP OUT AIR TEMP R3C5	A-EVAP OUT AIR TEMP R3C6	A-EVAP OUT AIR TEMP R4C1	A-EVAP OUT AIR TEMP R4C2
A-EVAP OUT AIR TEMP R4C3	A-EVAP OUT AIR TEMP R4C4	A-EVAP OUT AIR TEMP R4C5	A-EVAP OUT AIR TEMP R4C6

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- Conclusion
  - Adaptive freeze control test procedure is less time consuming and capable of capturing any freeze conditions, so that the control head software could be optimized before release for production
  - Needs a lot of runs of 10 to 15 minutes to get the compressor clutch cycling and decision making to get the Evap grid to lower, whereas the standard procedure is easy to run in the drive cell with no decision making during the test.